Larval and juvenile fishes associated with pelagic Sargassum in the north-central Gulf of Mexico

Larval and Juvenile Fishes Associated with Pelagic *Sargassum* in the Northcentral Gulf of Mexico

ERIC R. HOFFMAYER[1*], JAMES S. FRANKS[1], BRUCE H. COMYNS[2], J. READ HENDON[1], and RICHARD S. WALLER[1]

[1]*Center for Fisheries Research and Development*
The University of Southern Mississippi
Gulf Coast Research Laboratory
P.O. Box 7000
Ocean Springs, Mississippi 39566 USA

[2]*Department of Coastal Sciences*
The University of Southern Mississippi
Gulf Coast Research Laboratory
P.O. Box 7000
Ocean Springs, Mississippi 39566 USA

eric.hoffmayer@usm.edu

ABSTRACT

The information reported herein, which was obtained as part of a larger study, pertains to the identification and enumeration of larval and juvenile fishes associated with pelagic *Sargassum* in the northern Gulf of Mexico. From 2000 to 2002, over 18,000 pelagic larval and juvenile fishes were collected using bongo and neuston nets. The diversity of fishes was high, with 110 species collected representing 69 genera and 57 families. The dominant families, in order of numeric abundance of specimens, were Exocoetidae, Carangidae, Clupeidae, Gerreidae, Mugilidae, Scombridae, Balistidae, and Monacanthidae. The family Carangidae was represented by the greatest number of species (n = 16) followed by Scombridae (n = 9), Exocoetidae (n = 9), and Monacanthidae (n = 8).

KEY WORDS: Gulf of Mexico, Habitat, and *Sargassum*

Larvas y Juveniles de Peces Asociados con el Sargaso Pelágico y Zonas de Frentes en la Parte Central del Norte del Golfo de México

Como parte de un estudio extenso, la información reportada aquí pertenece a la identificación y cuantificación de larvas y juveniles de peces asociados con *Sargassum* pelágico en el Norte del Golfo de México. Desde el año 2000 al 2002, mas de 20,000 larvas y juveniles de peces pelágicos fueron colectados usando redes bongo y neuston. La diversidad de peces fue alta, 110 especies representan 69 géneros y 57 familias. Las familias dominantes, ordenadas en abundancia numérica de ejemplares, fueron Exocoetidae, Carangidae, Clupeidae, Gerreidae, Mugilidae, Scombridae, Balistidae, y Monacanthidae. La familia Carangidae fue representada por el mayor numero de especies (n=16) seguida por Scombridae (n = 9), Exocoetidae (n = 9), y Monacanthidae (n = 8).

PALABRAS CLAVES: Golfo de Mexico, Habitat, y *Sargassum*

INTRODUCTION

Juveniles of many species of fish use inshore estuarine areas as a nursery habitat where food and refuge from predators can be found; however, valuable nursery habitat also exists in the offshore environment in the form of pelagic *Sargassum* (Butler et al. 1983, Coston-Clements et al. 1991). Pelagic *Sargassum*, a brown algae, is transported into the Gulf of Mexico by the Yucatan Current (Loop Current), where it forms large isolated mats, scattered clumps, and long windrows, depending on sea conditions. Aggregations of pelagic *Sargassum* provide food and refuge for small fishes and invertebrates (Dooley 1972, Coston-Celements et al. 1991). In recent years, *Sargassum* has been given considerable attention as essential fish habitat (EFH) in the offshore environment. In September 2003, the National Marine Fisheries Service approved the Fishery Management Plan (FMP) for pelagic *Sargassum* habitat in the U.S. South Atlantic, developed by the South Atlantic Fishery Management Council (SAFMC, 2003), strengthening the need to collect valuable information on the organisms utilizing this critical habitat. Only a few studies have examined the fish communities associated with *Sargassum* in the Gulf of Mexico (Bortone et al. 1977, Wells and Rooker 2003), and these studies primarily focused on juvenile fishes. Little is known about the abundance and distribution of pelagic *Sargassum* in the Gulf of Mexico throughout the year, and even less is known about which fish species utilize this habitat during their early life stages. The objective of this study, which is part of a larger investigation, was to identify and enumerate the larval and juvenile fishes that utilize pelagic *Sargassum* habitat in the offshore environment of the northcentral Gulf of Mexico.

MATERIALS AND METHODS

Sampling Locations and Shipboard Procedure

From May 2000 to September 2002, sampling was conducting during 14 research cruises in the northcentral Gulf of Mexico (Figure 1). *Sargassum* was located by aerial surveys, and neuston and bongo nets were used to collect fish. A "large mesh" neuston (LN) net (1 m x 2 m frame, 3.2 mm mesh net) was towed through *Sargassum* to sample juvenile fishes within or immediately below the *Sargassum*. A "small mesh" neuston (SN) net (1m x 2m frame, 947 mm mesh Nitrex net) was used to sample larval and juvenile fishes adjacent to (from 5 - 15 meters) *Sargassum*; tows were made at the surface for a 10-minute duration following Comyns et al. (2002). Paired bongo nets (60 cm mouth diameter, 0.333 mm mesh net) were towed at the surface adjacent to *Sargassum* (five minute duration) and also down to a depth of 50 meters (oblique tow). Mechanical flow meters were used to measure the volume of water sampled in the bongo nets. Samples were washed, concentrated with a sieve, preserved with 95 % ethanol, and returned to the laboratory for sorting and identification. Fishes were identified to the lowest possible taxon.

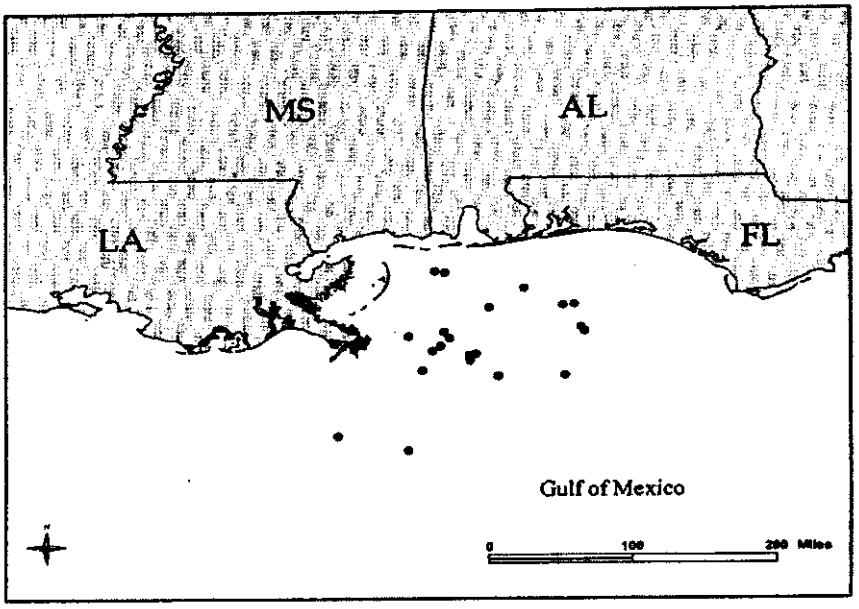

Figure 1. Sampling locations from May 2000 to September 2002. Circles indicate sampling locations.

RESULTS

A total of 18,749 fishes were taken in 138 collections. Of the 138 collections, 23 were taken through *Sargassum*, 88 were surface tows taken adjacent to *Sargassum* (59° SN, 29° BN), and 27 were oblique tows adjacent to *Sargassum*. Surface tows adjacent to *Sargassum* produced the greatest number of fishes (16,032 fishes), followed by collections through *Sargassum* (1,769 fishes), and oblique tows (948 fishes). The diversity of young fishes was high, with 110 species collected representing 69 genera and 57 families (Table 1). The actual number of species would be higher because 19 taxa identifications extended only to the family level.

Flyingfishes (Exocoetidae, 3,939) and jacks (Carangidae, 3,642) were the dominant fishes identified in this study (Table 2). Herrings (Clupeidae) were the third largest group with 2,937 fish; however, 2,201 herrings were collected in one net tow alone. Other abundant families were the mojarras (Gerreidae), tunas (Scombridae), mullets (Mugilidae), triggerfishes (Balistidae), filefishes (Monacanthidae), sea chubs (Kyphosidae), and damselfishes (Pomacentridae; Table 2).

Table 1. Total number and relative abundance of larval and juveniles fishes associated with pelagic Sargassum in the northern Gulf of Mexico as presented by sample collection category. Fishes are identified to the lowest possible taxon.

	Surface Adjacent[1]		Through Sargassum[2]		Oblique Adjacent[3]	
Family	No. Fish	% Rel. Abd.	No. Fish	% Rel. Abd.	No. Fish	% Rel. Abd.
Moringidae	1	0.01	0	0.00	0	0.00
Muraenidae	22	0.14	0	0.00	0	0.00
Ophichthidae	7	0.04	0	0.00	22	2.32
Clupeidae	2893	18.05	0	0.00	44	4.64
Harengula jaguana	6	0.04	0	0.00	0	0.00
Sardinella aurita	48	0.30	0	0.00	0	0.00
Etrumeus teres	191	1.19	0	0.00	0	0.00
Opisthonema oglinum	12	0.07	0	0.00	0	0.00
Engraulidae	42	0.26	0	0.00	35	3.69
Anchoa hepsetus	1	0.01	0	0.00	1	0.11
Stomiiformes	0	0.00	0	0.00	2	0.21
Gonostomatidae	16	0.10	0	0.00	0	0.00
Cyclothone sp.	1	0.01	0	0.00	24	2.53
Melanostomatidae	1	0.01	0	0.00	0	0.00
Bathophilis sp.	0	0.00	0	0.00	1	0.11
Eustomas sp.	0	0.00	0	0.00	1	0.11
Synodontidae	0	0.00	0	0.00	6	0.63
Paralepidae						
Paralepis atlanticus	0	0.00	0	0.00	1	0.11
Myctophidae	36	0.22	0	0.00	101	10.65
Diaphus sp.	0	0.00	0	0.00	28	2.95
Lampanyctus nobilis	0	0.00	0	0.00	1	0.11
Antennaridae						
Histrio histrio	34	0.21	79	4.47	0	0.00
Ogcocephalidae	1	0.01	0	0.00	0	0.00
Bregmacerotidae						
Bregmacerous cantori	0	0.00	0	0.00	25	2.64
Bregmacerous sp.	1	0.01	0	0.00	5	0.53
Phycidae						
Urophycis sp.	4	0.02	0	0.00	0	0.00
Ophidiidae	2	0.01	0	0.00	1	0.11
Belonidae	12	0.07	0	0.00	1	0.11
Platybelone argalus	1	0.01	0	0.00	0	0.00
Exocoetidae	63	0.39	0	0.00	0	0.00
Exocoetus obtusirostris	31	0.19	0	0.00	0	0.00
Parexcocoetus brachyp-terus	67	0.42	0	0.00	0	0.00
Oxyporamphus microp-terus	495	3.09	0	0.00	1	0.11
Prognichthys occidentalis	2739	17.08	4	0.23	22	2.32
Hirundichthys affinis	147	0.92	0	0.00	0	0.00
Cheilopogon melanurus	10	0.06	11	0.62	0	0.00
Cheilopogon exsiliens	240	1.50	0	0.00	1	0.11
Cheilopogon furcatus	101	0.63	0	0.00	0	0.00
Cheilopogon cyanopterus	1	0.01	0	0.00	0	0.00
Cheilopogon sp.	6	0.04	0	0.00	0	0.00

Table 1 continued.

Hemiramphidae	8	0.05	0	0.00	0	0.00
Atherinidae	17	0.11	0	0.00	2	0.21
Holocentridae	1	0.01	0	0.00	0	0.00
Labridae	1	0.01	0	0.00	1	0.11
Synganthidae						
Syngnathus pelagicus	6	0.04	12	0.68	0	0.00
Syngnathus louisianae	17	0.11	11	0.62	0	0.00
Scorpaenidae	2	0.01	0	0.00	1	0.11
Triglidae	0	0.00	0	0.00	2	0.21
Nomeidae	2	0.01	0	0.00	0	0.00
Nomeus gronoui	2	0.01	0	0.00	0	0.00
Cubiceps pauciradiatus	21	0.13	0	0.00	14	1.48
Psenes maculates	1	0.01	0	0.00	0	0.00
Psenes cyanophrys	13	0.08	0	0.00	0	0.00
Dactylopteridae						
Dactylopterus volitans	0	0.00	0	0.00	1	0.11
Serranidae	2	0.01	0	0.00	11	1.16
Serraninae	0	0.00	0	0.00	1	0.11
Centropristis sp.	1	0.01	0	0.00	0	0.00
Serranus sp.	0	0.00	0	0.00	6	0.63
Anthiinae	0	0.00	0	0.00	3	0.32
Hemanthias vivanus	2	0.01	0	0.00	1	0.11
Grammistinae	0	0.00	0	0.00	2	0.21
Priacanthidae	2	0.01	0	0.00	3	0.32
Priacanthus arenatus	3	0.02	0	0.00	0	0.00
Apogonidae	1	0.01	0	0.00	0	0.00
Rachycentridae						
Rachycentron canadum	2	0.01	0	0.00	0	0.00
Echeinidae	2	0.01	0	0.00	0	0.00
Remora sp.	3	0.02	0	0.00	0	0.00
Carangidae	85	0.53	11	0.62	72	7.59
Seriola dumerili	28	0.17	1	0.06	0	0.00
Seriola fasciata	20	0.12	9	0.51	0	0.00
Seriola rivoliana	28	0.17	17	0.96	0	0.00
Seriola zonata	2	0.01	0	0.00	0	0.00
Seriola sp.	109	0.68	1	0.06	0	0.00
Decapterus punctatus	8	0.05	1	0.06	0	0.00
			15			
Caranx crysos	771	4.81	2	8.59	0	0.00
Caranx latus	1	0.01	0	0.00	0	0.00
Caranx ruber	34	0.21	1	0.06	5	0.53
Caranx hippos/latus	15	0.09	0	0.00	0	0.00
	180	11.2				
Caranx sp.	6	6	2	0.11	26	2.74
Trachurus lathami	55	0.34	0	0.00	26	2.74
Chloroscombrus chrysurus	69	0.43	0	0.00	2	0.21
Elegatis bipinnulata	78	0.49	6	0.34	0	0.00
Trachinotus carolinus	16	0.10	0	0.00	0	0.00
Selar crumenopthalamus	63	0.39	0	0.00	0	0.00
Oligoplites saurus	117	0.73	0	0.00	0	0.00
Selene sp.	1	0.01	0	0.00	4	0.42
Coryphaenidae						
Coryphaena equisetis	8	0.05	0	0.00	3	0.32
Coryphaena hippurus	44	0.27	0	0.00	5	0.53
Coryphaena sp.	3	0.02	0	0.00	3	0.32
Lutjanidae						
Lutjanus sp.	0	0.00	1	0.06	0	0.00
Pristiponoides aquilonaris	1	0.01	0	0.00	3	0.32

Table 1 continued.

Lobotidae						
Lobotes surinamensis	78	0.49	42	2.37	0	0.00
	149					
Gerreidae	8	9.34	0	0.00	0	0.00
Mullidae	34	0.21	0	0.00	0	0.00
Kyphosidae						
Kyphosus incisor	141	0.88	7	0.40	0	0.00
Kyphosus sp.	113	0.70	45	2.54	0	0.00
Chaetodontidae	1	0.01	0	0.00	0	0.00
Pomacanthidae						
Holocanthus bermudensis	0	0.00	0	0.00	1	0.11
Pomacentridae						
			17			
Abudefduf saxatilis	99	0.62	1	9.67	1	0.11
Mugilidae						
			31			
Mugil curema	775	4.83	1	17.58	1	0.11
Mugil cephalus	8	0.05	0	0.00	0	0.00
Mugil sp.	47	0.29	0	0.00	0	0.00
Sphyraenidae						
Sphyraena barracuda	106	0.66	0	0.00	0	0.00
Sphyraena guachancho	1	0.01	0	0.00	0	0.00
Sphyraena borealis	6	0.04	0	0.00	1	0.11
Sphyraena sp.	3	0.02	0	0.00	0	0.00
Scaridae	22	0.14	0	0.00	0	0.00
Blenniidae	59	0.37	0	0.00	41	4.32
Hypsoblennies sp.	10	0.06	0	0.00	0	0.00
Microdesmidae	3	0.02	0	0.00	1	0.11
Gempylidae	1	0.01	0	0.00	0	0.00
Gempylus serpens	17	0.11	0	0.00	1	0.11
Trichiuridae						
Trichiurus lepturus	1	0.01	0	0.00	14	1.48
Scombridae	14	0.09	0	0.00	8	0.84
Thunnus thynnus	10	0.06	0	0.00	4	0.42
Thunnus atlanticus	36	0.22	0	0.00	5	0.53
Thunnus albacores	9	0.06	0	0.00	2	0.21
Thunnus sp.	116	0.72	0	0.00	33	3.48
Auxis thazard	796	4.97	0	0.00	33	3.48
Auxis rochei	34	0.21	0	0.00	8	0.84
Auxis sp.	18	0.11	0	0.00	8	0.84
Euthynnus alletteratus	315	1.96	0	0.00	9	0.95
Scomberomorus maculatus	4	0.02	0	0.00	3	0.32
Scomberomorus cavalla	1	0.01	0	0.00	1	0.11
Katsuwanus pelamis	3	0.02	0	0.00	0	0.00
Istiophoridae	50	0.31	0	0.00	0	0.00
Bothidae	3	0.02	0	0.00	8	0.84
Cyclopsetta chittendeni	0	0.00	0	0.00	3	0.32
Cyclopsetta sp.	2	0.01	0	0.00	1	0.11
Trichopsetta ventralis	1	0.01	0	0.00	3	0.32
Citharichthys macrops	1	0.01	0	0.00	1	0.11
Citharichthys spilopterus	1	0.01	0	0.00	2	0.21
Citharichthys sp.	0	0.00	0	0.00	2	0.21
Syacium sp.	2	0.01	0	0.00	7	0.74
Bothus sp.	1	0.01	0	0.00	16	1.69
Etropus sp.	1	0.01	0	0.00	0	0.00
Cynoglossidae						
Symphurus plaguisa	0	0.00	0	0.00	3	0.32
Symphurus sp.	8	0.05	0	0.00	23	2.43

Table 1 continued.

Balistidae	7	0.04	0	0.00	0	0.00
Balistes capriscus	199	1.24	56 6	32.00	3	0.32
Canthidermis sufflamen	3	0.02	1	0.06	0	0.00
Canthidermis maculata	24	0.15	4	0.23	0	0.00
Monocanthidae	1	0.01	0	0.00	0	0.00
Monocanthus hispidus	273	1.70	23 3	13.17	0	0.00
Monocanthus setifer	5	0.03	15	0.85	0	0.00
Monocanthus ciliatus	2	0.01	2	0.11	0	0.00
Monocanthus sp.	4	0.02	45	2.54	0	0.00
Cantherhines pullus	4	0.02	0	0.00	0	0.00
Cantherhines macrocerus	0	0.00	1	0.06	0	0.00
Aluterus heudeloti	0	0.00	1	0.06	0	0.00
Aluterus scriptus	6	0.04	3	0.17	0	0.00
Aluterus schoepfi	0	0.00	2	0.11	0	0.00
Ostraciidae	2	0.01	0	0.00	0	0.00
Lactophyrs sp.	1	0.01	0	0.00	0	0.00
Tetraodontidae	2	0.01	1	0.06	0	0.00
Sphoeroides sp.	5	0.03	0	0.00	1	0.11
Diodontidae						
Diodon hystix	3	0.02	0	0.00	0	0.00
Diodon holocanthus	1	0.01	0	0.00	0	0.00
Chilomycterus schoepfi	0	0.00	1	0.06	0	0.00
Unidentified Fish	338	2.11	0	0.00	18 0	18.9 9
Total	160 32		17 69		94 8	

[1]Small mesh neuston and bongo net
[2]Large mesh neuston
[3]Bongo net

Within *Sargassum*

Large larval and small to mid-sized juvenile fishes were abundant within *Sargassum* habitat, but the diversity of fishes was relatively low (12 families, 27 species) (Table 1). Collections were dominated by triggerfishes, filefishes, jacks, frogfishes (Antennaridae), sea chubs, tripletail (Lobotidae), pipefishes (Syngnathidae), and mullet. Triggerfishes and filefishes were the two most abundant groups within the habitat, accounting for 49 % of the fishes collected. The gray triggerfish, *Balistes capriscus,* was the most abundant species, followed by the planehead filefish, *Monacanthus hispidus*. Jacks, primarily the genera *Caranx* and *Seriola,* and sea chubs, predominantly the yellow chub, *Kyphosus incisor*, accounted for 11 % and 3 % of the fish collected within the habitat, respectively.

Table 2. Family representation of the top ten families of fishes collected in association with pelagic *Sargassum*.

Family	Total Number	Relative Abundance
Exocoetidae	3,939	21.0%
Carangidae	3,642	19.4%
Clupeidae*	3,194	17.0%
Gerreidae**	1,498	8.0%
Scombridae	1,470	7.8%
Mugilidae***	1,142	6.1%
Balistidae	807	4.3%
Monacanthidae	597	3.2%
Kyphosidae	307	1.6%
Pomacentridae	271	1.4%
Total	18,749	

* 2,201 were collected in 1 net tow.
** 1,243 were collected in 2 net tows.
*** 1,138 were collected in 3 tows.

Adjacent to *Sargassum*

Surface waters adjacent to *Sargassum* contained the highest diversity of fishes and collections consisted of 97 species representing 54 families (Table 1). Exoceotids were the most numerically abundant fish collected at the surface and one of the most diverse, consisting of nine species. The flyingfish, *Prognichthys occidentalis*, was the most abundant species collected adjacent to *Sargassum*, and in fact, during the entire study. Carangids were the second most abundant family collected at the surface as well as the most diverse, consisting of 16 species (Table 1). *Caranx* was the most abundant genus, accounting for 72 % of carangids collected, and consisted primarily of *Caranx crysos* (29 %) and unidentified *Caranx* (69 %). Other families common in these collections were gerreids, scombrids, and mugilids. The scombrids were the second most diverse family collected adjacent to *Sargassum*, consisting of nine species representing five genera. The frigate mackerel, *Auxis thazard*, was the most abundant scombrid, followed by the little tunny, *Euthynnus alletteratus*. In addition, 174 specimens of tuna were collected, including bluefin, *Thunnus thynnus*, yellowfin, *Thunnus albacores*, blackfin, *Thunnus atlanticus*, and skipjack, *Katsuwanus pelamis*.

Sub-surface

Oblique tows yielded the lowest number of fish collected in this study. These collections were dominated by jacks, lanternfishes (Myctophidae), tunas, herrings, flounders (Bothidae), and tonguefishes (Cynoglossidae) (Table 1). The tunas were represented by eight species but were dominated numerically by the genera *Thunnus* and *Auxis*. The flounders were the second most diverse family with seven species representing six genera.

DISCUSSION

The faunal communities associated with pelagic *Sargassum* have been examined in the Gulf of Mexico (Bortone et al. 1977, Wells and Rooker 2003), western Atlantic (Dooley 1972, Bulter et al. 1983, Coston-Clements et al. 1991, Settle 1993), and Pacific (Gooding and Magnuson 1967, Kingsford and Choat 1985, Edgar and Aoki 1993). The majority of these studies focused on juvenile fishes living in a close association with *Sargassum*. Dooley (1972) reported 23 families, 36 genera, and 54 species of fishes associated with *Sargassum* in the waters of the Florida Current. Bortone et al. (1977) reported 15 families, 24 genera, and 40 species associated with *Sargassum* in the eastern Gulf of Mexico, and Wells and Rooker (2003) reported 17 families, 26 genera, and 37 species associated with *Sargassum* in the western Gulf. Settle (1993) sampled juvenile fishes within *Sargassum* and larval fishes inhabiting surface waters around *Sargassum* in the Atlantic and identified 99 species, representing 53 genera and 36 families.

The present study is the most comprehensive study to date on the larval and juvenile fishes associated with pelagic *Sargassum*, and over 110 species consisting of 69 genera and 57 families have been identified thus far. Of the 110 fish species and 57 families collected in the present study, 64 species and 36 families have not previously been recorded in association with *Sargassum* in the Gulf of Mexico. In addition, 22 families and 47 species found during this study were not reported from *Sargassum* communities in the Atlantic and Pacific.

Studies examining fishes living within *Sargassum* (Fine 1970, Dooley 1972, Bortone et al. 1977, Kingsford and Choat 1985, Moser et al. 1998, Wells and Rooker 2003), reported the dominant species to be jacks, triggerfishes, filefishes, pipefishes, and the Sargassum fish. The present study reports a similar species composition in collections taken within *Sargassum*. The Sargassum fish, *Histro histro*, Sargassum pipefish, *Syngnathus pelagicus,* and chain pipefish, *Syngnathus louisianae,* were commonly found within the habitat itself. Small tripletail, triggerfishes, and filefishes typically occurred immediately below *Sargassum*, but were often observed moving in and out of the habitat (Hoffmayer, personal observation). Jacks and sea chubs were abundant approximately 0.5 to 1.0 m below the *Sargassum*, but since these fishes are very mobile and evade the gear easily, their numbers are grossly underreported in this study.

The neuston and bongo nets towed at the surface of the water adjacent to *Sargassum* produced the largest number and greatest diversity of fishes in this study. Similar methods were used by Settle (1993) to collect larval and juvenile fishes from surface waters adjacent to pelagic *Sargassum* off North Carolina, and the species composition in his collections was similar to that of this study. In the Atlantic, only three individual billfishes were collected in association with *Sargassum* (Settle 1993), however, 62 were collected in the present study. In addition, scombrids were the fifth most abundant family of fishes collected in this study but were absent in Settle's (1993) collections. Although the sampling effort in Settle's (1993) study was not reported, it may

have been substantial, because their numbers of fishes collected far exceeded that of this study. Both scombrids and istiophorids are known to spawn in Gulf of Mexico waters (Scott et al. 1993, Brown-Peterson et al. In press), and the presence of these fishes in our collections suggests that adults may be spawning at or within the vicinity of *Sargassum* with larvae being transported to convergent zones with entrained *Sargassum* by ocean currents (Langmuir 1938, Kingsford 1990). The absence of scombrids in Atlantic *Sargassum* studies is note worthy, and begets further study.

Waters sampled by oblique tows produced the lowest number of fishes in this study. Jacks, herring, and scombrids were most abundant in surface collections, and those collected in oblique tows may have been taken at or near the surface. Lanternfishes, flounders, and tonguefishes were more numerous in sub-surface tows and were most likely collected deeper in the water column. Bristlemouths (Gonostomatidae) and snake eels (Ophichthidae) were also more numerous in sub-surface rather than surface collections. Since oblique tows provide little information as to where these fishes are residing in the water column, discrete depth sampling is vital to understanding sub-surface fish communities in the vicinity of *Sargassum* habitat.

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